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ABSTRACT

Information necessary to understand many English sentences appears to be supplied by a source outside the sentence which is composed of a fund of knowledge accumulated throughout life. This fund of knowledge may be visualized and a conceptual network into which the incomplete information supplied by a sentence can be mapped, thus making it possible for the reader to fill in the missing pieces of the conceptual situation designated by the sentence. Such a conceptual network would seem to be the source, also, of the various kinds of expectation concerning the contents of those parts of the sentence which the reader has not yet read which help the reader to resolve lexical and relational ambiguities. A greater awareness of this function of the reader's conceptual universe might lead to an improvement of instructional and remedial strategies for the teaching of the interpretative language skills. References are included. (Author/MS)

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Reading, Understanding, and Conceptual Situations(+)

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A b s t r a c t

In the course of a long-term research project aimed at enabling a computer to analyse and code ("understand") the meaning of ordinary English sentences, it became clear that much of the information necessary to understand many, if not most, sentences is not to be found in the sentences themselves but must be supplied from another source. For the human reader this source is the fund of "knowledge" he has previously accumulated, both through living experience and through linguistic experience. This fund of knowledge is here visualised as a conceptual network onto which the incomplete information supplied by a sentence can be mapped, thus making it possible for the reader to fill in the missing pieces of the conceptual situation designated by the sentence. Such a conceptual network would seem to be the source, also, of the various kinds of expectation (concerning the contents of those parts of the sentence which the reader has not yet read) which help the reader to resolve lexical and relational ambiguities. - It is suggested that a greater awareness of this function of the reader's conceptual universe might lead to an improvement of instructional and remedial strategies for the teaching of the interpretive language skills.

Reading, Understanding, and Conceptual Situations

Introduction

The background from which this contribution springs is rather odd - so odd, indeed, that many a teacher of reading might be inclined to discard it at first sight. While most of you have been predominantly interested in the ways and means of teaching children to process and understand written language, I have spent my time trying to teach just that to a computer. But between children and computers there still is, fortunately for us all, a world of difference. Computers are very quick and very accurate, but they certainly manifest none of the self-reliance, the independence, the originality, and the charm that so often encourage and stimulate us in our dealings with children. Thus, the similarities are few and, at best, very tenuous, and the differences are overwhelming. Still, there <u>are</u> similarities, especially if we confine ourselves to studying the acquisition of one specific skill.

There are overwhelming differences, too, between a seamstress and a sewing machine; yet, with regard to that one skill of sewing, viewed as a process that leads from a given input to a required output, there are similarities that are both interesting and instructive. Above all, whoever it was who first hit upon the idea of mechanising the process of sewing, was at once compelled to define, investigate, and analyse that process in a much more minute and accurate way than had ever been necessary before. Similarly, if we intend to make a machine understand sentences, we have to look much more closely at the process of understanding than seems necessary in the case of children, because very many children, we must admit, pick it up quite successfully

even when it is taught in the most haphazard way. Hence it may not be quite unreasonable to expect that at least some of the insights that proved helpful in the work with machines will be of use also in an attempt to facilitate or to speed up the learning process in children.

The use of the word "understanding" should make it clear that I am here not concerned with word recognition in speech or written material, nor with any of the sensory or perceptual activities involved. I am concerned exclusively with the processing of linguistic input that has already been recognized as such by the receiving organism.

Paul Ziff, an eminent linguist and logician, has recently stated (Ziff, 1970) that we don't know what we are talking about when we use the verb "to understand" (+). He may be justified from a formal logical point of view. I would suggest, however, that, in practice, we have a fairly clear idea of what it is that a child has to learn in order to read and to comprehend or understand a sentence. The trouble is that linguists, almost without exception, have tended to study language as a ready-made observable phenomenon and, as good scientists do in other branches, they have been intent upon discovering regularities, patterns, and rules that might help them to isolate, classify, and describe as much as possible of the phenomenon's immediately manifest character. Noam Chomsky, today unquestionably the best known figure in linguistics,

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(+) Throughout this text double quotes are used to indicate that the marked item is to be taken as word-token; single quotes are used to indicate that the marked item is to be taken as designatum, i.e., as the concept or conceptual structure semantically linked to the word or word combination. Italics (here rendered by underlining) are used to stress an item or to restrict its connotation to a specific technical one.

has repeatedly made this point with admirable clarity; for instance in his Aspects of the Theory of Syntax, he says on page 9:

> To avoid what has been a continuing misunderstanding, it is perhaps worth while to reiterate that a generative grammar is not a model for a speaker or hearer. ... When we speak of a grammar as generating a sentence with a certain structural description, we mean simply that the grammar assigns this structural description to the sentence. When we say that a sentence has a certain derivation with respect to a particular generative grammar, we say nothing about how the speaker or hearer might proceed, in some practical or efficient way, to construct such a derivation.

This warning, it would seem, has not been reiterated often enough. There are still linguists and psycholinguists who would have us believe that a grammar based on the structural and morphological regularities of the manifest linguistic material, i.e. the surface characteristics of words and word combinations, can supply us with a useful model for language acquisition, which is intended to include the process of language interpretation, or understanding, which the child has to acquire in order to read successfully.

Fortunately, however, there are today also quite a few language analysts and psychologists - Piaget, Ceccato, Lenneberg, Hays, Schank, to mention only some - who have made it clear that, whatever a model of a language processing organism might eventually be like, it will have to be based on a plausible model of cognitive development.

Conceptual Structures

This is not the place to describle fully a possible model of cognitive development. All I can hope to do within the restricted space at my disposal, is to illustrate by means of a few examples how given pieces of language may be linked to certain cognitive or conceptual

structures and that such links are crucial in the process we call understanding.

The early stages of a child's cognitive development were summarily hypothesised by Piaget almost half a century ago. Since then, quite a number of salient points in his hypotheses have been experimentally strengthened; others have remained less solid, but it is only fair to say that, at least in part, this is so because of the extreme difficulty of setting up really conclusive experiments and tests with subjects that are as yet incapable of verbal communication. Be this as it may, there seems to be little doubt today that the construction of relatively durable object concepts (object conservation), and of some basic relational concepts with which to connect the static objects, are among the very first cognitive achievements of the child. It also seems very plausible now that the relational concepts are first derived from the various efforts the child makes to coordinate his own motor sequences to the visual and tactual data patterns it has come to hold constant in the form of object representations (Piaget's sensory-motor stage).

Although an infant of a few months of age is, of course, still very far from having a conscious concept of 'activity' and of 'causation', the motor patterns it learns to implement (e.g. to reach for, grasp, and shake a rattle) already contain elements which, at a much later stage, will be categorized as 'causative agent', 'actor', 'activity', 'object', and 'caused effect' or 'result'. And these are the very elements of which the kind of situation is constituted that the child learns to express in language by means of a subject, a verb, and various complements. In order to achieve this linguistic expression, the child must learn to

master the semantic connections by means of which his language (e.g. English) designates individual conceptual items, i.e. 'objects' which speakers of English normally hold constant, as well as relational concepts, i.e. the relations which link individual conceptual items in a given situation. As we shall see, this dichotomy between individual static items and the relational concepts that link them is only very approximately reflected on the linguistic level by the grammarian's division between words (lexical items) and sentence structure (syntax).

The child will have to learn, for instance, that the sentences (1) through (7) must all be referred to one and the same conceptual situation:

1) The baby shakes his rattle.

2) The rattle is shaken by the baby.

3) The rattle shakes and rattles.

4) The rattle rattles.

5) The baby rattles with his rattle.

6) The baby rattles.

7) The baby's rattling (irritates father).

It would be of little help to the child (who, we can safely assume, is not much concerned with grammatical description) if a linguist were to tell it, for instance, that sentence (2) can be generated by means of transformation and substitution rules from sentence (1), for the linguist would be quite unable to provide any further <u>linguistic</u> rules for the generation of sentences (4), (5), (6), and (7). It is, indeed, difficult to see how anyone could understand (or, for that matter, produce) such a set of sentences unless he had developed the conceptual network that enables him to assign, to the items designated by the individual words,

the roles they are playing in the event to which the given sentence refers. Moreover, some of the sentences do not even contain words for all the items that, in fact, play important roles in the event. In the sentences (3) and (4), for instance, the causative agent is in no way designated; and in the sentences (6) and (7) it is the item that actually performs the activity of "rattling" (i.e. "the rattle") that remains wholly implicit. - The examples also demonstrate that a grammatical parsing that yields parts of speech does not help us with the assignation of roles.

Thus, the conclusion seems inescapable that in order to understand even relatively simple sentences we must integrate such information as the sentences themselves yield, with information that we have to provide ourselves. This additional information need not be linguistic information, in the sense that it was obtained from or through the use of language. It frequently is, and sometimes can only be, experiential information.

If we look at the above sentences, we can see very quickly that the experiential information required to understand them, consists primarily of the following static and relational concepts:

(A) a causative agent (e.g. designated by "baby") which causes

(B) a non-causative item (e.g. designated by "a rattle") to perform

(C) an activity (e.g. designated by "to shake") which, in turn, causes

(D) an activity (e.g. designated by "to rattle").

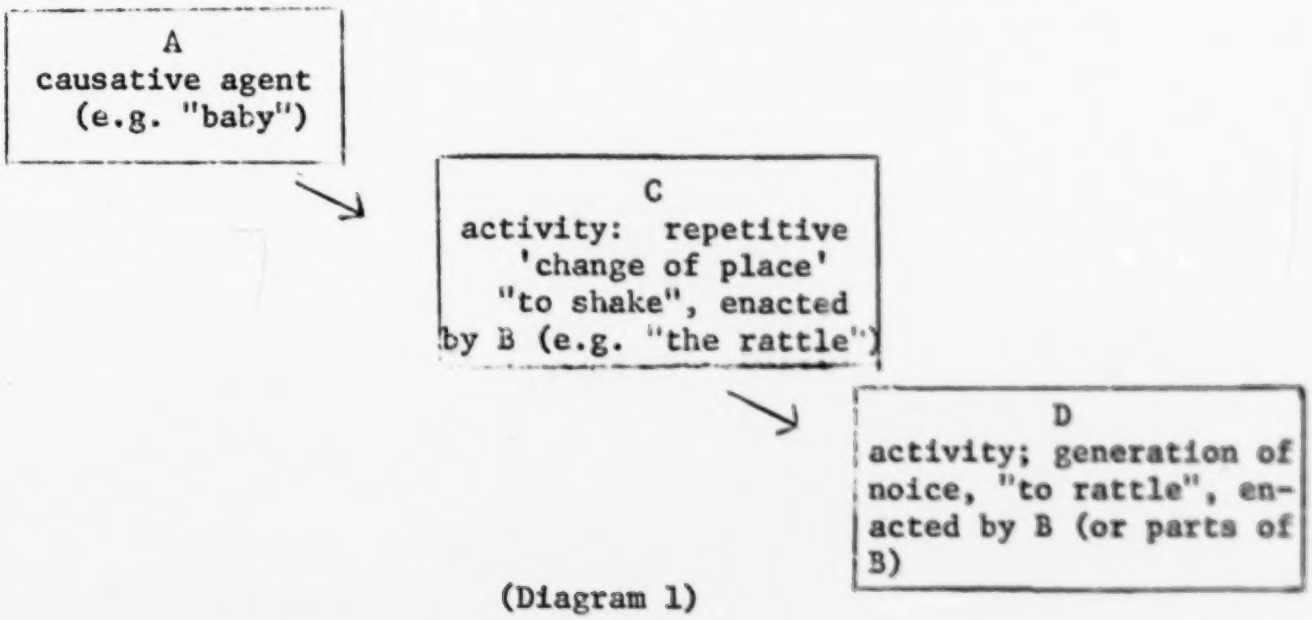
Apart from this information at least four pieces of lexical information are also relevant:

- that "baby" designates the type of item that can function as 'causative agent';
- that "rattle" designates the type of item that can enact both the activities designated by "to shake" and "to rattle";

- that "to shake" designates an activity that involves repetitive 'change of place';

- and that "to rattle" designates an activity that involves the emission of a specific repetitive type of noise.

We can roughly sketch this conceptual situation as follows:



(Diagram 1)

In time, as experiential knowledge increases, the conceptual structure will become much more detailed. The causal nexus between (A) and (C) will be specified as mechanical causation (motion imparted by mechanical force, e.g. through prehensile contact); the production of noise will be specified as caused by the intermittent contact of two items; the particular acting object "rattle" (B) will be specified as a purposive instrument consisting of at least two items that can make and break contact with one another; and so on.

Only when these conceptual refinements (and others pertaining to other situations) have been incorporated, will the child be in a position to understand sentences of the kind:

8) The shutters were rattling in the wind.

9) The old pump was rattling in the yard.

10) The prisoner was rattling his chains.

11) The cart rattled down the hill.

It is easy to see that the determination of grammatical subject and object is again of little help in the process of understanding, if by "understanding" we mean the correct assignation of roles in the described event. In fact, none of the things we can possibly find to say about the syntactic structure of these sentences tells us with any certainty which linguistic item designates the causative agent and which the performing actor in the conceptual situation designated by the verb "to rattle". What the syntactic structure does tell us in a good many cases, is which of the linguistic constituents of the sentence designates the particular conceptual situation to which the interpreter (or reader) must turn for such further information as he requires to achieve his interpretation. Both "rattle" and "rattles", for instance, may designate either the activity or the acting item, and their place in the word sequence helps us to decide whether, in the sentence at hand, they designate the dynamic conceptual situation or the static concept that happens to function as an acting item.

In short, from the words and their sequential arrangment in the English phrase or sentence we glean a certain number of semantic and syntactic indications, but in very many cases these indications are insufficient to reconstruct the actual situation to which the piece of language refers. A full reconstruction is then possible only if we map the gleaned indications onto a pre-existing network of conceptual items and relations.

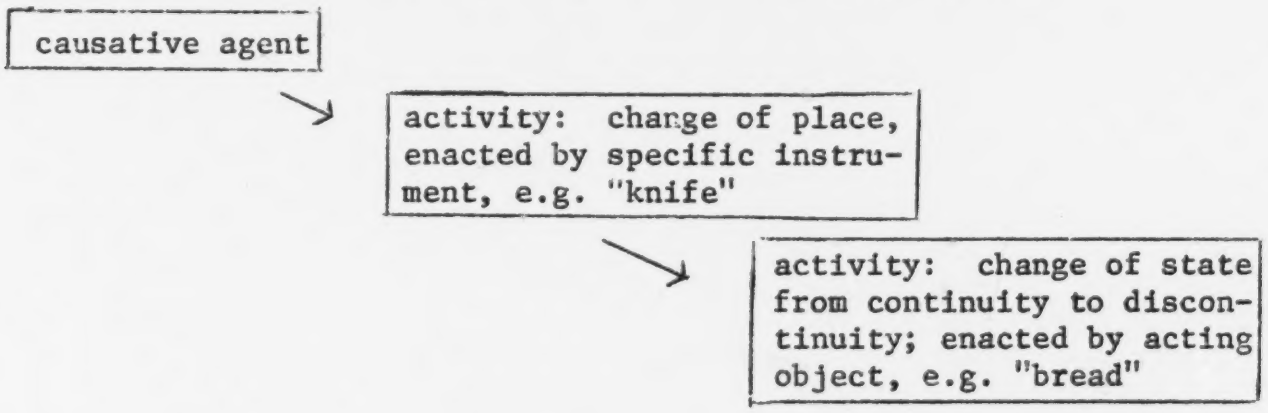
Let us look at another example:

12) Charley cuts bread very well

13) This knife cuts bread very well

14) This bread cuts very well

We could scarcely understand these sentences if we could not resort to a conceptual situation that is the same for all three because it is determined by the activity designated by "to cut" and not by what happens to be grammatical subject or object on the linguistic level. Again we can sketch this conceptual structure, and we get the following layout:


causative agent
activity: change of place, enacted by specific instrument, e.g. "knife"
activity: change of state from continuity to discontinuity; enacted by acting object, e.g. "bread"

(Diagram 2)

Only when we are able to reconcile what we already know about the single items designated by the words of the sentence with the specific requirements of a known conceptual situation, can we say that we have understood the sentence. Each item, as it were, has to be fitted into a specific slot of the conceptual network and, fortunately, it is relatively rare that a sentence specifies several items that could be fitted equally well into one and the same slot (or into the slots of several different conceptual situations).

The assignation of roles is by no means the only interpretive problem that has to be decided in this way. A pre-established network is no less indispensable in determining to which item a modifier is to be related.

In examples (15) through (22) the formal structure of the sentence does not tell us to which item the property designated by the last word of the string is to applied; nor does it always tell us whether this last word, in the case at hand, designates a property or something else.

15) He climbed the hill fast.

16) He bent the wire down.

17) He bent the wire cold.

18) He sliced the ham thin.

19) He bought his car new.

20) He painted the car silver.

21) He offered the client silver.

22) He finished the race exhausted.

With the exception of "new", all the terminal words in these sentences, taken by themselves as lexical items, have more than one potential function in ordinary usage. "Thin" and "exhausted" can function as verbs. "Cold" can function as noun. "Fast" and "silver" can function both as noun and as verb. "Down" can function as verb, as noun, and as preposition. Besides, "fast" and "silver" are amoiguous also in one of their grammatical functions. The first, in its function as modifier, can be roughly synonymous to "speedy", to "tight", or to "indelible"; the second, in its function as noun can designate either a material or a colour. (One could, of course, go on adding to this list of ambiguities - for instance, "cold" as temperature and "cold" as a physical disorder - but the list is quite long enough to illustrate the points I want to make.)

Given this proliferation of potential functions, how does it come about that the reader, in practice, has very little if any doubt as to

what the terminal word means and to what other item its modifying function is to be applied? Let me try to outline a possible procedure.

In sentence (15) "climbed", following directly upon "he", can be identified with near certainty as the personal form of a verb. As such it provides the central item of a dynamic conceptual situation. In fact, it designates an activity that involves a 'change of place' in an upward direction (unless there is the specification "down", which would invert the direction). Since in our example there follows the word "hill", which designates an item that fits very well into the slot provided by the second place, or place of arrival, in the 'change of place' structure, we are inclined to expect that the designation of the last word of the sentence will fit into the conceptual structure we have already built up, rather than that it will force us to reorganize the preceding items into a different conceptual structure. This expectation is, of course, based on our previous experience with the English language and has been fairly consistently reinforced by the fact that, in English, the word or word combination that designates the central conceptual structure tends to come rather early in the sentence. (For a detailed analysis of the different levels of expectation involved in the process of understanding see Schank, 1971.) Then, when we actually come upon the last word of the sentence, "fast" in our example, we do not even consider the potential activity-designation of that word because neither would the central activity around which we have already built a conceptual situation allow for a secondary activity to be added at this point, nor would we have a suitable 'acting object' that could be conceived as enacting this secondary activity. (This would be quite different if the sentence were

something like: "He saw the monks fast" or "He knew the monks fast", where the conceptual structures designated by "to see" and "to know" do provide a slot for a second activity). As to the potential noun-designation of "fast", this could become operative only if it provided us with a conceptual item that we could readily join to the item designated by "hill" without the latter losing its fitness for the slot we have called 'place of arrival'. (This would be the case if the last word were "side", making "hill side", or "track", making "hill track", but with the noun "fast" it does not seem plausible.) Thus we are left with the modifier-designations of "fast", and since the one that has to do with speed is overwhelmingly probable in a conceptual structure that clusters around a 'change of place' or 'motion', we apply the modification to the activity or, as a grammarian would say, we apply it <u>adverbially</u>.

I should not like to strain your patience by going through an hypothetical interpretive procedure for the remaining seven examples. Let me merely point out the variety of ways in which the designatum of the last word has to be linked to other items in the diverse situations.

In example (16) "down" specifies the direction of the acting object at the terminal point of the activity.

In example (17) "cold " specifies a condition of the acting object before and during the activity.

In example (18) "thin" specifies a property of the results of the specific transformative activity, i.e. a property of the <u>slices</u> into which the ham is transformed.

In example (19) "new" specifies a condition of one of four items involved in the activity of 'reciprocal transfer' designated by "to buy"

(the buyer, the seller, the item acquired by the buyer, and the item, e.g. money, received, or to be received, by the seller).

In example (20) "silver" specifies a property of the transformed item, i.e. a property that is the result of the specific transformative activity.

In example (21) "silver" designates the acting object of an activity of 'transfer' that is merely projected by the activity designated by "to offer".

In example (22) "exhausted" specifies a condition of the acting object at the terminal point of a 'change of state', i.e. the change from 'activity' to 'non-activity' designated by "to finish".

A Conceptual Universe

These rough sketches of conceptual situations by no means exhaust the relational network that could be uncovered in each one of them. But, rough as they are, they serve well enough to illustrate the amount and the complexity of well-specified notions (as to the semantic structure of lexical items and the relations into which, potentially, they can be fitted) - notions which are indispensable to the reader if he is to understand linguistic expressions, even if neither syntax nor lexical items in the expressions are in any way out of the ordinary.

The number and variety of these notions and, beyond that, the question as to how they may be accumulated and integrated into a relatively coherent conceptual universe, should now help us to bring into focus one of the big and as yet unbridgeable differences between the attempts to teach reading to a child and to a computer. The child, when it reaches the age at which reading is usually contemplated, has had a good four or five years of living experience during which he has built up at least a skeleton of his

conceptual universe and he has had at least two or three years of linguistic experience supplying a multitude of information with which to extend and to substantiate that skeletal structure. - A computer has had none of that; and unless we can supply it ready-made or can program an efficient self-learning procedure, the day when a computer will read and understand ordinary English is not likely to come.

Though the type of analysis of conceptual situations I have tried to outline in these pages has sprung from work with computers, it does, I believe, throw a little light on some aspects of language and language skills that many linguists leave in the dark.

As long as the analysis of a piece of language yields merely rules for the transformation of one formulation into another and rules for the generation of sentences from a deep structure whose components are no less linguistic than the generated result, the corpus of these rules will be of very little help to either the student or the teacher of a linguistic skill such as reading. For the crucial step in the interpretation of written (or, indeed, of spoken) language is not the step from one <u>linguistic</u> structure to another, but the step from a linguistic expression to a non-linguistic conceptual representation. As I have tried to show, the conceptual situation is often only summarily specified by the explicit linguistic input. Understanding, therefore, requires a varying amount of additional information that necessarily has to be gathered from a pre-established conceptual network.

The failure to understand a given sentence may, thus, not always be due to a lack of <u>linguistic</u> competence - it could be caused equally well by a gap in the reader's conceptual universe. Although this has, of course,

been well known insofar as the reader's vocabulary is concerned, we have only recently become fully aware of the fact that the correct relational interpretation of sentence structure frequently depends on relational information which the syntax of the sentence itself does not supply.

No less important than this additional relational information is the creation, in the reader, of certain expectations concerning the content of parts of the sentence (or, indeed, text) that have not yet been input or processed. Again there can be little doubt that these expectations are generated when the reader maps information gathered from single words and phrases onto much larger pre-existing conceptual structures.

There are, then, at least two ways - related, but rather different in function - in which the reader's pre-established conceptual network is crucial to his understanding of a piece of language. If this is so, it may be worth while to examine existing methods of reading instruction and, especially, the remedial strategies designed for backward readers, in order to see whether these methods and strategies could not be improved from this specific point of view, i.e. whether they are, in fact, as efficacious as they could be with a view to developing the student's conceptual universe.

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